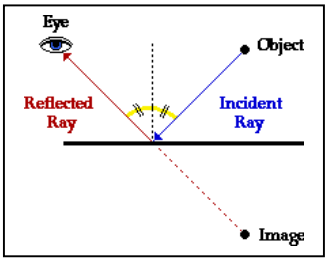


Activity #9

Title: The IR Challenge! -Teacher's Copy

(Class can be divided into two teams.)

National Science Education Standards:

Science Content Standards: 5-8

Science as Inquiry

CONTENT STANDARD A:
As a result of activities in grades 5-8, all students should develop

- **Abilities necessary to do scientific inquiry**
- **Understandings about scientific inquiry**

USE APPROPRIATE TOOLS AND TECHNIQUES TO GATHER, ANALYZE, AND INTERPRET DATA.

DEVELOP DESCRIPTIONS, EXPLANATIONS, PREDICTIONS, AND MODELS USING EVIDENCE. Students should base their explanation on what they observed, and as they develop cognitive skills, they should be able to differentiate explanation from description--providing causes for effects and establishing relationships based on evidence and logical argument. This standard requires a subject matter knowledge base so the students can effectively conduct investigations, because developing explanations establishes connections between the content of science and the contexts within which students develop new knowledge.

Physical Science

- **CONTENT STANDARD B: grades 5-8**
- Light interacts with matter by transmission (including refraction), absorption, or scattering (including reflection). To see an object, light from that object--emitted by or scattered from it--must enter the eye.

The sun is a major source of energy for changes on the earth's surface. The sun loses energy by emitting light. A tiny fraction of that light reaches the earth, transferring energy from the sun to the earth. The sun's energy arrives as light with a range of wavelengths, consisting of visible light, infrared, and ultraviolet radiation.

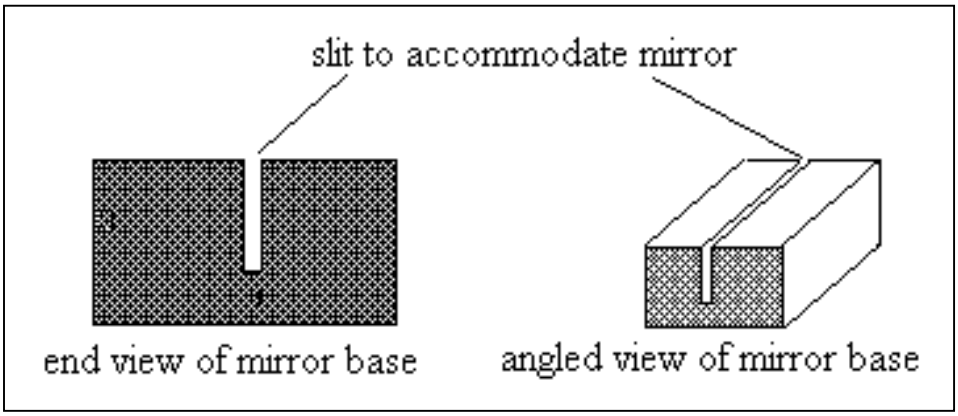
Purpose:

- To prove that infrared energy can be reflected by mirrors in much the same way as visible light
- To infer that infrared energy is very similar to visible light in many respects and that both are components of the same electromagnetic spectrum.

Note to the Teacher:

- One VCR (or other similar appliance) with remote controllers required for each team (Hope you're friendly with the A-V coordinator in your school!)
- Eight mirror bases, made from either 4" sections of 2 x 4 lumber (see diagram below) or from wads of modeling clay, will have to be prepared prior to this activity. (Students can not rely on

the hope they can merely hold the mirrors perfectly still throughout the duration of this activity.) The slit in the section of 2 x 4 is merely a saw kerf cut down the center.



- Depending upon the length of your class period, you can set the time limit for the first trial test accordingly.
- Depending upon the layout of your classroom, a team's four mirrors may be set up across a couple of lab stations at waist height…or possibly on the floor as a last resort (although this is difficult to use "line-of-sight" to arrange the mirrors).

Materials: 4 flat, silvered mirrors (100mm x1000mm) per team, 4 mirror bases per team, 1 IR-controlled appliance/remote controller per team, 1 metric tape measure, two 6" squares of aluminum foil

Sources for Materials:

- Flat, silvered mirrors, 100mm x 100mm, Frey Scientific, 100 Paragon Parkway, P.O. Box 8101, Mansfield, OH 44903---2002 catalogue, # 15563606, $1.35 each (when ordering 6 or more)
- Power tape measure, 12' x ½" blade, has English and metric rulings; Frey Scientific, 100 Paragon Parkway, P.O. Box 8101, Mansfield, OH 44903---2002 catalogue, #15565912, $7.10
- Mirror bases, cut approx. 5" in length from 2 x 4 lumber (available at local lumber yards), $2.50 per each 8-footer.

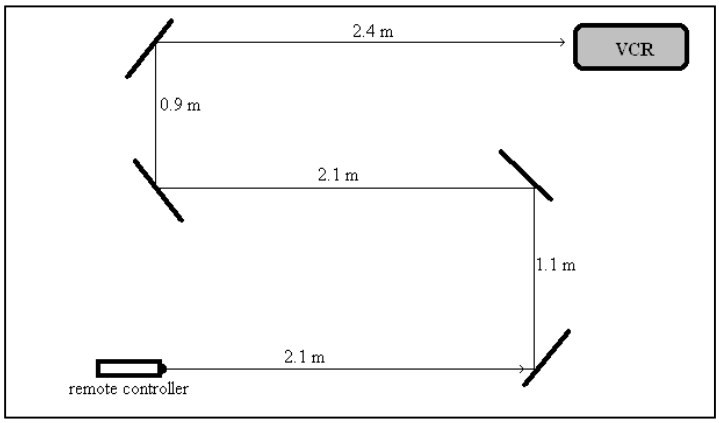
The Challenge: Reflect the beam from an infrared controller off as many of the four mirrors as possible to turn on the appliance. Sound easy? Well, there's a slight "catch" here.

- Your team's score will be calculated by MULTIPLYING the **# of mirrors** used by the **total distance in meters** that the beam travels and then DIVIDING that answer by the **number of attempts** required to successfully complete the challenge…according to the following formula:

$$\frac{\text{(\# of mirrors X distance in meters)}}{\text{\# of attempts}}$$

- There will also be a time limit of _____ minutes that your team will have to prepare its challenge project for the first test trial.

- Your team will have to submit a diagram of the mirror layout with each "leg" of the IR energy's trip labeled in meters…such as in the sample diagram below:



- Oh yes…one last item that has not been mentioned yet: You will NOT have access to the IR remote controller during the setting up of your mirror arrangement prior to testing!! That's right—it's all done with visible light (line of sight)!
- Hint #1: Fold your square of aluminum foil a few times so that it is approximately 2" x 2". Cover various areas of the front of your appliance while operating the POWER ON feature of your remote controller from a short distance away. Repeat this procedure after moving the folded aluminum foil to different areas until you locate the internal IR receiver. Now, when aligning your mirrors for the challenge, zero in on this specific target area prior to your first (and hopefully ONLY) trial test!
- Hint #2: You MIGHT want to determine the maximum straight-line distance that your remote controller operates the appliance so that you don't arrange/space your mirrors to exceed that limit before the first trial test.

The accompanying answer sheet provides the necessary space for your diagrams and data to be recorded as well as two additional follow-up questions regarding observations made in this activity.